the sea breeze along this coast is very much less than the 38 per cent given by Davis for the New England coast; but this is largely because in the present investigation Kaiser has used only the days that show a land wind early in the morning and late in the evening, with a sea breeze in the immediate afternoon. These are, therefore, days with both sea and land wind, whereas Davis has considered principally the occurrence of the sea breeze. The geographic distribution of the sea breeze in this region differs in some respects from that found by students in other localities. When we chart the sea breezes observed at all of Kaiser's stations, we find that the bay in which Pillau is located experiences its sea breeze much later than the rest of the coast, and the same is true to a less extent of the bays represented by Swinemunde and Labagienen. At Neufahrwasser the sea breeze begins two hours later than at the two other stations, owing to its being protected by a cape jutting out to the northward.

With regard to the veering and backing of the wind there is considerable irregularity. The veering with the sun occurs only occasionally on this coast. There are four ways in which the wind may change: (1) continuous turning toward the right; (2) turning toward the right, followed by a backward motion toward the left; (3) continuous turning toward the left (backing), and (4) turning toward the left, followed by a retrogression or turning back toward the right. An examination of all the changes of the wind at the five Baltic stations shows that the third method almost never occurs, but the other three methods occur in about equal proportions. The rate at which the wind changes direction has been computed by Doctor Kaiser as an hourly rate, and varies between 0° and 28° per hour for changes toward the right, and from 0° to 47° per hour for changes toward the left. The change of direction when the sea breeze sets in is comparatively large, but the hourly change when it has attained its maximum strength is small.

The difference of pressure at sea level between two stations when the sea breeze is blowing is quite appreciable, amounting to fully half a millimeter of the mercurial barometer in the gradient between Swinemunde and the lightship, a hundred kilometers or sixty miles distant to the north, but becoming zero at the time when the land breeze or sea breeze dies away. We believe that this is the first time that these barometric gradients have been determined; we have often called attention to the fact that the air is so mobile that direct pressure gradients which are inappreciable to ordinary meteorological observations will suffice to make a strong wind, and that the gradients ordinarily shown on the weather maps, which are largely perpendicular to the direction of the wind, are the result of the centrifugal force of the wind on the rotating earth. Such slight gradients as those that drive the air thru a pneumatic tube are ordinarily neglected in meteorology, but we see them exemplified in the present case, where the gradient of a half millimeter per hundred kilometers produces a land breeze, or a sea breeze, of six meters per second. The difference of temperature of the air over the land and the sea for two stations nearly corresponding to those just mentioned was 5.7° C. at its maximum, and as this occurs at the time when the difference of pressure is the greatest and the sea breeze is the strongest Doctor Kaiser considers it to be the cause of these latter.

With regard to the distance to which the sea breeze extends landward or seaward, or the boundary between the region of land breeze and sea breeze, the author makes use of observations on board numerous ships. He finds that in general it is certain that on the German Baltic the sea breeze begins between four and five nautical miles from the coast, and that in its turn the land wind stretches even farther seaward; on the most favorable days the land wind may stretch eight nautical miles seaward. These figures relate to clear, cloudless sky. It seems impossible now to determine how far the sea breeze extends inward over the land, since the interior stations have no continuous records; but we may assume that the sea breeze penetrates comparatively far inland on account of the flatness of the country, and it may be as far as twenty or thirty kilometers, judging by comparison with the conditions on the New England coast.—*C. A.*



## MONTHLY REVIEW OF THE PROGRESS OF CLIMATOLOGY THRUOUT THE WORLD.

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### METEOROLOGICAL STATIONS IN ICELAND.

The accompanying chart, fig. 1, shows the distribution of the meteorological stations now in operation in Iceland. For the revision of this chart to October, 1906, the writer is indebted to the courtesy of Mr. L. V. S. Willaume-Jantzen, Subdirector of the Danish Meteorological Institute.

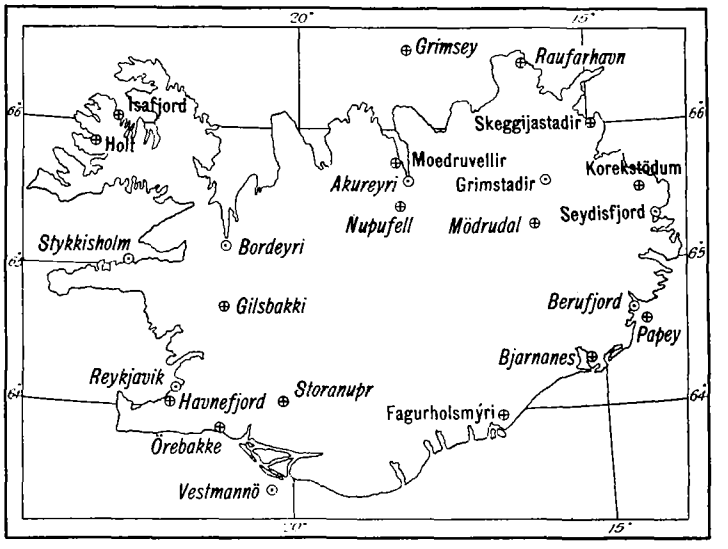


FIG. 1.—Meteorological stations in Iceland.

*Elements observed:* ⊕ Temperature. ⊙ Temperature and pressure. Many stations also observe wind, atmospheric humidity, and precipitation. Italics denote stations for which normals of any element have been published. (See text.)

The results of observations at the stations in Iceland are published annually in the second part of the Meteorologisk Aarbog of the Danish Meteorological Institute.

The stations whose names are italicized are those for which normals, of one element or more, have been published. The following are the principal collections of normals for Iceland:

Denmark. Danske meteorologiske Institut. Meteorologiske Middeltal og Extremer for Fåeroerne, Island og Gronland. (Appendix til det danske meteorologiske Instituts Aarbog 1895, II Del.). Kjobenhavn, 1899.

Willaume-Jantzen, V. Climat du littoral islandais. (Extr. Congrès maritime international de Copenhague, 1902.)

For Stykkisholm the best normals are those of J. Hann. See his important studies of the meteorology of Stykkisholm in Sitzungsberichte der mathematisch-naturwissenschaftlichen Klasse der kaiserlichen Akademie der Wissenschaften, Vienna, 113 Bd., Abt. IIa, 1904, pp. 183–269, and Meteorologische Zeitschrift, Jahrg. 22, 1905, pp. 354–357.

Normals for Reykjavik, the capital of Iceland, from a series of observations made 1823–1837, appear in the Zeitschrift der österreichischen Gesellschaft für Meteorologie, Bd. 6, 1871, p. 45. Normals from a later series appear in Buchan's "Report on Atmospheric Circulation".

Temperature normals for the following stations not shown on the accompanying chart are also given in Buchan's "Report

on Atmospheric Circulation": Flatey, Siglufjore, Skagerstrand.

CLIMATE OF BRITISH EAST AFRICA.

A recent British Colonial Report (Annual, No. 475) contains the following sketch of the climate of the British East Africa Protectorate:

Climatically, British East Africa, which extends approximately from 5° south to 4° north latitude, may be divided into three zones:

1. *The coast.*—The coast strip, including the valleys of the three principal rivers, the Sabaki, the Tana, and the Juba. This is essentially tropical. The atmosphere is always charged with a considerable amount of moisture, but the temperature is equable and never very high. From June to December, during the prevalence of the southwest monsoon, residence on the coast is far from unpleasant, and although it is hotter during the other six months of the year, the nights are always fairly cool. On the whole the health of the coast belt is good; there is very little malaria, and yellow fever—the scourge of the tropical coasts of the Western Hemisphere—is unknown. Farther inland, in the scrub country and in the river valleys, the effect of the sea breeze is lost, and the climate is hotter and less agreeable. Malaria is also more common, but can not be said to be very prevalent or of a severe type.

2. *The highlands.*—Leaving the coast belt a gradual rise is experienced till an altitude of 9000 feet above sea level is reached on the Mau, or 18,000 on snow-clad Mount Kenia. On the whole of these uplands the climate is excellent, healthy, and invigorating. Although the sun is fairly strong in the middle of the day, European clothing can be worn all the year round, and the nights are cold enough to render the use of two or more blankets indispensable. The fact that children born and bred on these high plateaux grow up rosy and robust is sufficient evidence of the excellence of the climate.

3. *The district around Lake Victoria Nyanza.*—From the highlands a somewhat rapid descent is made to the depression in which lies Lake Victoria. This is 3680 feet above sea level, and a tropical climate is again met with. It is hot, and owing to the vicinity of high hills thunderstorms are of frequent occurrence. The climatic conditions are less favorable [to health], and at certain seasons of the year malarial and hæmoglobinuric fevers are not infrequent.

TABLE 1.—*Rainfall summary, British East Africa, 1896–1904.*

| Station. | Length of record. | Average rainfall. | Station. | Length of record. | Average rainfall. |
|---|---|---|---|---|---|
| | *Years.* | *Inches.* | | *Years.* | *Inches.* |
| Kismayu | 9 | 14.66 | Machakos | 7 | 35.82 |
| Malindi | 7 | 36.07 | Nairobi | 5 | 36.24 |
| Takaungu | 6 | 45.55 | Fort Hall | 4 | 48.21 |
| Mombasa | 6 | 51.95 | Eldama Ravine | 2 | 37.80 |
| Shimoni | 8 | 56.28 | Mumias | 5 | 73.42 |
| Mwatate | 2 | 22.66 | Kisumu | 2 | 51.23 |

CLIMATE OF TULAGI, SOLOMON ISLANDS.

From the latest colonial report on British Solomon Islands (annual, No. 461), we extract the following table of rainfall as recorded at the government station at Tulagi, together with a brief sketch of the climate.

TABLE 2.—*Rainfall of Tulagi, Solomon Islands, 1897–1905.*

| Month. | 1897. | 1898. | 1899. | 1900. | 1901. | 1902. | 1903. | 1904. | 1905. | Mean: 1898–1904. |
|---|---|---|---|---|---|---|---|---|---|---|
| January | ..... | 9.51 | 14.27 | 12.20 | 10.93 | 18.31 | 3.96 | 14.78 | 5.62 | 11.99 |
| February | ..... | 28.55 | 12.04 | 3.09 | 12.46 | 27.76 | 14.12 | 17.61 | 21.20 | 16.52 |
| March | ..... | 27.89 | 17.47 | 13.48 | 10.83 | 22.39 | 10.73 | 23.49 | ..... | 18.04 |
| April | ..... | 6.67 | 20.48 | 2.29 | 6.75 | 8.53 | 5.68 | 6.75 | ..... | 8.16 |
| May | ..... | 4.19 | 8.85 | 5.83 | 17.59 | 4.55 | 3.84 | 10.77 | ..... | 7.95 |
| June | ..... | 4.86 | 1.26 | 3.20 | 10.69 | 7.85 | 7.99 | 2.12 | ..... | 5.42 |
| July | ..... | 4.86 | 24.27 | 3.24 | 5.53 | 9.02 | 7.79 | 4.32 | ..... | 8.43 |
| August | ..... | 9.94 | 8.33 | 3.01 | 13.24 | 14.70 | 14.28 | 8.91 | ..... | 10.34 |
| September | ..... | 10.53 | 10.92 | 5.41 | 10.35 | 6.25 | 10.03 | 5.53 | ..... | 8.44 |
| October | 2.91 | 10.23 | 11.21 | 9.12 | 15.60 | 6.65 | 10.39 | 7.01 | ..... | 10.03 |
| November | 5.66 | 21.14 | 7.89 | 10.62 | 7.97 | 6.83 | 10.69 | 3.35 | ..... | 9.78 |
| December | 11.03 | 8.97 | 19.03 | 10.83 | 11.91 | 9.86 | 16.76 | 6.00 | ..... | 11.91 |
| Year | ..... | 147.39 | 156.02 | 82.33 | 133.85 | 142.70 | 116.26 | 110.64 | ..... | 127.03 |

It will be gathered from the table that the months from December to March, the season of the northeast monsoon, are the wettest, and that the months from April to September, the season of the southeast trade wind, are those during which less rain falls. No period of the year can, however, rightly be called a dry season. June appears to be the month when least rain is to be expected. The septennial average for July is affected by the abnormal rainfall for that month recorded during the year 1899, when about 17 inches of rain fell in two days. This appears to have been an altogether exceptional phenomenon. The comparatively small total for the year 1900 is remarkable when compared with the annual totals for the remainder of the septennial period.

The southeast trade-wind season may be said to set in during March or April and to continue until November. During the months from November to March long periods of calm weather are experienced, varied by westerly and northwesterly winds, which sometimes blow with considerable force; but cyclonic storms, such as prevail during this season in more southerly latitudes, are unknown in the Solomons.

In the absence of proper instruments it has been impossible to keep any record of temperature or barometric pressure. A thermometer on the veranda at the government residence at Tulagi, about 220 feet above sea level, has never recorded a lower night temperature than 73° F., and during the cooler months, June to September, rises to about 86° to 88° during the day. During the hot months, December to February, a temperature of 92° has occasionally been observed when the heat has not been tempered by a breeze off the sea.

THE CLIMATE OF SEISTAN.

Col. Sir Henry McMahon, head of the British Seistan Mission of 1903–5, contributes some interesting notes on the climate of that region to the September and October, 1906, numbers of the Geographical Journal.

Seistan, as Lord Curzon has recently remarked, is "famous for a wind, the most vile and abominable in the universe".

Colonel McMahon says:

If ever a country merits the title of "land of the winds" it is Seistan. Everyone who has visited Seistan, or written about Seistan, has mentioned its celebrated wind, called the "Bad-i-sad-o-bist roz", or wind of 120 days, which blows in the summer. Few of these have had the misfortune to experience it, but as we went through two seasons of this wind we are able to say something about it. It more than justifies its reputation. It sets in at the end of May, or the middle of June, and blows with appalling violence and with little or no cessation till about the end of September. It always blows from one direction, a little west of north (between 316½° and 333¾°), and reaches a velocity of over 70 miles an hour. It creates a pandemonium of noise, sand, and dust, and for a time gets on one's nerves; but it is in reality a blessing in disguise, for it blows away the insects, which from April to June make life in Seistan a perfect purgatory, mitigates the awful summer heat, and clears the country of typhus, smallpox, and other diseases rife in the country in May and June. This Bad-i-sad-o-bist roz is not felt in the mountainous country west and northwest of Seistan. It is said to be even more violent in Lash Jowain than in Seistan. It is less violent in Herat, and rapidly decreases in violence south of Seistan.

One would think this 120-day wind enough, but violent winds prevail all through the winter from December to April, and blizzards are of constant occurrence. These winds always come from the same direction. The winter blizzards are terrible, and the wind attains a terrific velocity. In a blizzard at the end of March, 1905, the anemometers registered a maximum of 120 miles an hour. The average velocity for a whole sixteen hours was over 88 miles an hour.

The effects of the wind are everywhere visible in Seistan. Everything looks wind-swept and wind-stricken. Over the greater part of the country not a single tree exists. The present villages and habitations are all built with their backs presenting lines of dead wall on the windward side. The old ruins are oriented at exactly the same angle, on account of the wind.

The wind has buried large tracts of country under sand. Many of the old ruined towns are wholly or partly buried in sand, and this burying process goes on all the year and every year, and is covering up not only valuable lands, but inhabited villages.

Seistan has only two seasons, winter and summer; spring and autumn do not exist. One jumps within a few hours from cold winter into hot summer, and from hot summer into cold winter. The summer lasts from April to November, seven months, and is a long weary period of cloudless sky and great heat, which reaches a maximum in the shade for many months of 110° to 119° F.

We learn from the last administrative report of the Indian Meteorological Department that the Seistan Mission has presented to that department meteorological records extending from June, 1903, to May, 1905, together with a note on the climate of Seistan by Colonel McMahon.

Another recent account of the climate of Seistan is that of Mr. Ellsworth Huntington, contained in Publication No. 26 of the Carnegie Institution, "Explorations in Turkestan, with an Account of the Basin of Eastern Persia and Seistan" (Washington, 1905), p. 227.

## REPRINTS OF WORKS ON METEOROLOGY.

We have quite lately learned that the friends of science in Japan have taken steps toward the reprinting of the mathematical works of Prof. Dr. Diro Kitao, professor of physics in